Title: Patterns, Patterns Everywhere

Brief Overview:

This investigation will allow students to recognize, describe, and extend patterns. Tasks are designed to move students through a hierarchy of steps and from the concrete to the abstract level. Students will use the constant function on the calculator to show skip counting and solve problems. In cooperative learning groups, students will build, create, and explain patterns.

Links to Standards:

- **Mathematics as Problem Solving**
Students will demonstrate their ability to solve problems in mathematics including problems with open-ended answers, problems which are solved in a cooperative atmosphere, and problems which are solved with the use of technology.

- **Mathematics as Communication**
Students will demonstrate their ability to communicate mathematically. They will read, write, and discuss mathematics with language and the signs, symbols, and terms of the discipline.

- **Mathematics as Reasoning**
Students will demonstrate their ability to reason mathematically. They will make conjectures, gather evidence, and build arguments.

- **Mathematical Connections**
Students will demonstrate their ability to connect mathematics topics within the discipline and with other disciplines.

- **Number Sense & Operations**
Students will demonstrate their ability to describe and apply number relationships using concrete and abstract materials. They will choose appropriate operations and describe effects of operations on numbers.

- **Patterns & Relationships**
Students will demonstrate their ability to recognize numeric and geometric relationships and will generalize a relationship from data.

Grade/Level:

Grade 3

Duration/Length:

This series of lessons will take 5 or 6 one-hour class periods, which need not be consecutive.

Prerequisite Knowledge:

Students should have working knowledge of the following:

- repeated addition
- concept of equal

Objectives:

Students will:

- copy, continue, and describe various patterns.
- use problem-solving strategies to build a pattern when given a description.
- use constant function on calculator to skip count.
- organize information and find regularity in patterns.
- work cooperatively in groups.

Materials/Resources/Printed Materials:

- pattern blocks
- cards labeled A,B,C,D - one set for each cooperative group
- construction paper with letters A,B,B,C, on the back- three sets
- Teacher Resource #3,4,5 -run on different colored paper, cut into cards and paper clipped for each group
- calculators
- "Two Ways to Count to Ten" from <u>African Wonder Tales</u>

Development/Procedures:

Task One: Becoming a Patternmaker

- Introduce the study of patterns by sharing the story "Becoming a Patternmaker" on Teacher Resource #2.

- Tell students to imitate/copy a simple pattern like: tap, clap, clap, nose, tap, clap, clap, nose.... Lead   students to the point where they can copy and continue your pattern. Ask students to orally describe the patterns you are creating. Let students make up their own patterns for the class.

- Introduce the following vocabulary words:
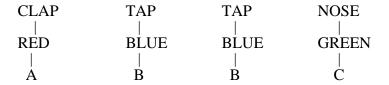 **core-** the smallest sequence (such as red, red, blue)
  term -the individual units that make up the core (such as red)

- Using pattern blocks, the students will copy and continue at least 3 patterns modeled by teacher. (Example: red, blue, blue, green, red, blue, blue, green...)

- Using A,B,C,D cards, students will be able to copy and continue patterns. (Example: A,B,B,C,A,B,B,C...)

- See Student Resource #1 for additional practice.

Task Two: Seeing the Same Pattern Depicted More Than One Way

- This activity will integrate the previous activities to show the pattern represented more than one way <u>at the same time</u>.

- Choose 8 students to demonstrate for class. Student will make a pattern using tap, clap, clap, nose, tap, clap, clap, nose... .(ABBC sequence)

- Choose another 8 students to demonstrate for class. These students will have a piece of colored construction paper. Using the blank side, they will form a color pattern in the ABBC sequence.

- Choose another group of 8 students to demonstrate for class. These student will form an ABBC sequence pattern using the letter side of the construction paper.

- Now have all the students combine the patterns at the same time.

CLAP	TAP	TAP	NOSE
RED	BLUE	BLUE	GREEN
A	B	B	C

- Divide students into groups of 8. Give out materials and let groups create their own integrated patterns.

> **Teacher Note:** Make sure the color of the paper is not always represented with the same letter (e.g.. Yellow is not always A.)

- Allow students to share their patterns with the class. Teacher can do informal assessment with this activity and reteach where necessary.

> **Teacher Note:** There is a hierarchy of steps to use when teaching patterns. The above task was designed to take students through the first three steps: COPY, CONTINUE, DESCRIBE. See Teacher Resource #1 for entire hierarchy.

- See Student Resource #2 for Journal Writing/Critical Thinking Activity.

Task Three: Let's Continue Patterns

- Divide students into cooperative groups of 4.

- Give each group a set of 4 cards (See Teacher Resource #3,4,5).

- Each student will read their own card and use the information to construct a pattern using all 4 cards. (Make sure students realize that criteria on all 4 cards must be met.)

- Teacher checks work and gives another set for group to complete.

- Give each group a blank set of cards to create their own pattern description. (See Teacher Resource #6)

- **Send-a-Problem:** Students "send" their set to another group to solve.

- Journal Writing/Critical Thinking Question Which is harder, building a pattern from directions or creating your own pattern? Tell why you feel this way.

Task Four: Fun With Skip Counting

- Introduce concept of skip counting by reading "Two Ways to Count to Ten" from African Wonder Tales. (If book is not available, see SIEST-96 page 6 for synopsis of story) OR

- Introduce by playing the game of Buzz where every second or third child says "Buzz" instead of the next number.

- Discuss skip counting as a pattern (2,4,6,8,10) and a quicker way to get to higher numbers.

- Pass out calculators and demonstrate how to skip count to 10 using the constant function by pressing 0 + 2 = and continue to press the =.

- Have students practice by completing problem on Student Resource #3. (Encourage them to use calculators and skip count.)

- Journal Writing/Critical Thinking Question - Which is faster, skip counting to 30 by 3's or to 100 by tens?

Task Five:** All Star Baseball**

- Use Student Resource #4 to introduce Baseball Problem.

- Ask questions to get their thinking started:
  "What information do you need to solve this problem? How can we organize this information so that it will be easier to work with? Guide students to the desired response of making a table.

- Make a table and record the first three entries. Pose the question "What do you see happening to the numbers in this sequence?" and give students time to think-pair-share.

- Allow students to orally explain the relationship between the bats and players.

- Have students complete the next few terms based on the relationship they found.

- Guide students as they work through the next problem and let them complete other 2 independently. Students should be encouraged to use the strategy of making a table.

- Use problem on Student Resource #5 for additional practice.

- Journal Writing/Critical Thinking Question - See Student Resource #5.

- See Student Resource #6 for additional problem solving practice.

Task Six: Breaking the Code

- Introduce by telling class "I have in front of me an entire class of patternmakers. You now possess a very powerful tool that will help you throughout your life. You can recognize patterns everywhere in life. Can you name some patterns in real-life?" Elicit answers like nature (Fibonnacci), pine cones, music, rainbows, poetry, books, calendars, flag, etc. "As a patternmaker, I want you to continue to identify patterns everywhere. Today we will use a pattern in the same way mathematicians do in the business world."

- Discuss codes, ciphers, and cryptology. Background information about G.H. Hardy could also be given.

- Students will decipher code on Student Resource Sheet #7 to show connection of patterns to real-world.

- Journal Writing/Critical Thinking Question - See bottom of Student Resource #7.

Performance Assessment:

The assessment has been embedded throughout this learning unit. The Journal Writing/Critical Thinking Questions can be scored using the rubric on Teacher Resource 8.

Extension/Follow Up:

1. NSA Speakers Bureau
2. National Cryptologic Museum (outside Ft. George G. Meade, Maryland)
3. Art and Music Class - Teachers can identify patterns in art projects and musical pieces.
4. Language Arts - Students can write poetry based on patterns (rhyme, cinquain, acrostic)

Authors:

Marcia Berlin
Carole Highlands Elementary
Prince George's County, MD

Karen Covino
Hilltop Elementary
Anne Arundel County, MD

Teacher Resource #1

This learning unit takes a look at patterns in the world around us. Patterns and relationships help students to organize and synthesize information. The lessons will enable students to learn about patterns and relationships sequentially, using the hierarchy of patterns. This will show how you can help your students change the way they view the world.

PATTERNS

Copy

Continue

Describe

Build when given a description

Create

See pattern and make prediction

Organize information and find regularity in the data

Introduction - Becoming A Patternmaker

A small child was searching for patterns.   He tossed a coin to see if heads and tails would land in a pattern. But unfortunately, the heads and tails came out in a random order.   He looked at the toys in his toybox, but the toys did not form a pattern.   He peered into the box of cereal at breakfast, but he could not find a pattern. In school, he gazed into the tub of pattern blocks that his teacher kept at a center. He did not see a pattern in the tub of blocks, even though his teacher called them pattern blocks. The teacher saw the boy looking pensive and asked what was the matter. "I can't find a pattern in my toybox, in my cereal box or in this tub of blocks," the boy replied. Where are the patterns I am searching for?" "I think I can help you," answered the teacher. "A pattern must be **made** by someone like yourself. If you will allow me, I will show you how to become a patternmaker. I will also help you identify patterns made by others."

"Yes!" cried the boy. "I would like that very much." (Teacher asks class.)

   "Would all of you like to become patternmakers?"

There must be more triangles than any other shape.

A blue block must be the first block in the core.

Three different colors must be used.

No blocks can come after the green blocks in the core.

Begin the core with a yellow block.

Two green blocks must touch.

Put green blocks between red and blue blocks.

The blue block is last in the core.

The red block is first in the core.

The green block must touch the yellow block.

The blue block is last in the core.

The yellow block must not touch the blue block.

Teacher Resource #6
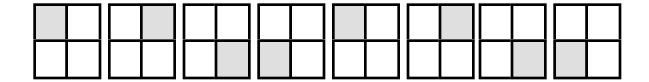
(For students to create their own pattern description.)

Make Your Own Pattern

Use shapes to make a pattern.

____ ____ ____ ____ ____ ____ ___ ____ ____ ____

Use numbers to make a pattern.

____ ____ ____ ____ ____ ____ ___ ____ ____ ____

Use colors to make a pattern.

____ ____ ____ ____ ____ ____ ___ ____ ____ ____

Use letters to make a pattern.

____ ____ ____ ____ ____ ____ ___ ____ ____ ____

Student Resource # 2

Journal Writing/ Critical Thinking

Describe this pattern.

Continue the pattern by drawing 6 more terms below.

The students in Mr. Reid's class are taking a field trip to the zoo. They will ride the bus, which holds 3 children to each seat. Joey wants to sit by a window. Every third child will get a window seat. If Joey is #26 in line, will he get a seat next to the window? *Convince the class your answer is correct.*

****   ALL STAR BASEBALL   ****

Nine students were selected for an All Star Baseball team from your school. Each player is dressed in an official uniform and has a baseball bat and glove.

Question 1. How many bats are there?

Question 2. What is the total number of fingers on all of the gloves?

Question 3. How many shoes do the team members have?

Question 4. What is the total number of toes that the team players have?

What information do we needs to solve the following problems?
What can we use to organize the information?
How do we organize the information?

Student Response #4a

Table 1   Players 1 2 3 4 5 6 7 8 9 10
           Bats   1 2 3 4 5 6 7 8 9 10

Table 2   Players 1 2 3
           Fingers 1 2 3
           on gloves

Table 3   Players
           Shoes

Table 4

Mrs. Smith's class is studying magnets and their strength. One group of students were able to lift 3 paper clips with one magnet, 6 paper clips with two magnets, and 9 paper clips with three magnets. How many magnets will they need in order to lift 27 paper clips? *Tell how you solved this problem.*

<u>Journal Writing/Critical Thinking</u>

What is the relationship between the number of magnets and the number of paper clips lifted?

The students at Bayside School are participating in a playday. One of the activities is the Bucket Brigade. The object of this game is to fill a trash can full of water, one bucket at a time. It takes 24 buckets of water to fill the trash can. The students can bring 6 buckets of water in one minute. If they keep the same speed, how many minutes will it take them to fill the trash can? After practicing, they find they can bring 8 buckets in one minute. Now how long will it take to fill the trash can? Show your work.

CRYPTOLOGY

Codes are used to send messages secretly to another person or country. Some mathematicians are hired to decipher these codes. Perhaps you may consider this interesting job when you are looking for a career. Decipher the message below using the letter pattern given. The message is a quote from a famous British mathematician named G.H. Hardy (1877 - 1947)

"Z LZSGDLZSHBHZN, KHJD Z OZHMSDQ

NQ ONDS, HR Z LZJDQ NE OZSSDQMR."

You will be a very good mathematician, if you continue to create patterns and see patterns in the world around you.

Journal Writing/Critical Thinking Question

What strategy did you use to "break" the code?

Teacher Resource Sheet #7

This codebreaker may be given to the students based on teacher judgment. Some students will be able to break the code without it.

Plain letters   A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
Cipher letters   Z A B C D E F G H I J K L M N O P Q R S T U V W X Y

Solution:

"A mathematician, like a painter or poet, is a maker of patterns."

Teacher Resource #8

Rubric for Journal Writing/Critical Thinking Questions

2   Fully explains and supports your answer.
        Shows understanding of mathematical concept.

1   Attempts to explain answer.
        Shows partial understanding of mathematical concept.

0   No effort / no response.